CHAPTER 10

Ecological Synthesis

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Introduction

The habitat suitability indices, although simplistic, reflect current available information and the best thinking of the teams of experts who created them. For the purpose of this synthesis, the models are considered to provide trends and degrees of ecological response that allow comparison of predrainage, current, and restored hydrologic conditions. In that context, the models may provide insights about how the selected landscape features and faunal groupings have changed with the drainage and compartmentalization of the Everglades, and how and to what degree the restoration of more natural hydropatterns will result in the restoration of desired ecological trends. A synthesis that examines patterns or themes common to more than one model can reveal relationships that are not apparent from an examination of each habitat suitability index model individually.

Ridge and Slough and Tree Island Sustainability

The ridge and slough habitat suitability index suggests that conditions for ridge and slough development were strongest in the natural system in the deep-water, prolonged-hydroperiod flow corridor of Shark River Slough. Conditions would have been less favorable for ridge and slough development in the more expansive peatlands to the north, although ridge and slough patterns are also evident there. By comparison, conditions for ridge and slough development in the current system are diminished in Shark River Slough and have shifted to central Water Conservation Area (WCA) 3A. Comprehensive Everglades Restoration Plan (CERP) water management policies seem to restore conditions favorable for ridge and slough development in Shark River Slough, while maintaining those in central WCA 3A.

Conditions favorable for ridge and slough development also appear to sustain tree islands. Both of the tree island habitat suitability index models, the species richness suitability index and the tree island suitability index, show similar broad patterns of habitat suitability for tree islands. Patterns common to both models indicate that conditions most favorable for tree islands, under both natural and restored conditions, occur in Shark River Slough extending northward into WCA 3B, in central WCA 3A, and

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in the central portion of the Arthur R. Marshall Loxahatchee National Wildlife Refuge (LNWR). Under current conditions, tree island habitat tends to be diminished both in quality and spatial extent in each of these areas in both models. Comparison of the ridge and slough and tree island habitat suitability indices shows a general overlay of areas of high tree island habitat suitability with areas of high ridge and slough habitat suitability.

Shifts in Habitat Suitability for Fauna between Shark River Slough and the Water Conservation Areas

Both the fish and alligator habitat suitability indices indicate a shift in high-suitability habitats from Shark River Slough and the oligohaline zone of the southern Everglades predrainage, to the artificially impounded areas of the water conservation areas under current conditions. Highly suitable habitat subsequently returns to the southern Everglades upon hydrologic restoration. The habitat shifts in fish and alligators followed shifts in conditions that were favorable for sustaining ridge and slough landscape patterns.

The fish habitat suitability index indicates that habitats in the natural system were close to ideal for the build-up of marsh fish densities throughout Shark River Slough. This was due to prolonged hydroperiod durations in the slough. The altered distribution of hydroperiod durations in the current system moves the habitat supporting highest densities of marsh fishes northward to artificially pooled areas of WCA 3 and LNWR. Conversely, the overdrained northern areas of WCA 3 and LNWR in the current system support reduced fish densities compared to the natural system. The return of prolonged hydroperiod durations to Shark River Slough in the restored system also returns high fish densities to the slough extending upstream throughout much of WCA 3B. The restored system also provides habitat supporting high fish densities in west-central WCA 3A and in the southern half of LNWR in areas of lesser fish habitat suitability under natural conditions.

The alligator habitat suitability index identifies Shark River Slough as the habitat most suitable for alligators under natural conditions. Under current conditions, alligator habitat has deteriorated in Shark River Slough, and has been replaced by areas of higher suitability in WCA 3 and LNWR. High-suitability alligator habitat returns to Shark River Slough in the restored system, while it remains in large tracts of central and southeastern WCA 3A, WCA 3B, and LNWR. However, increases in the alligator populations expected in edge habitat such as the marl marshes are not reflected in these alligator habitat suitability indices. The scale (2-miles by 2-miles) is too course to capture microtopographic variation such as alligator holes, animal tracks, and tree islands. Further, since most components of the index were developed using data from Shark River Slough, the application of the index throughout the Everglades system must be for comparisons of relative effects of alternatives only.

Production and Concentration of Marsh Fishes as Factors Controlling Wading Bird Reproduction

The decline in wading bird nesting in the Everglades is attributed both to altered patterns of production of marsh fishes and other prey organisms during wet periods, and to altered patterns of concentration and availability of those prey organisms to wading birds as water levels recede. The fish habitat suitability index indicates habitat suitability for the build-up of marsh fish population densities during wet periods across the ridge and slough landscape based on the distribution of hydroperiod durations. The wading bird habitat suitability index indicates habitat suitability for the concentration and availability of those fish populations to wading birds based on dry season water depths and water recession rates. Comparing the outputs from the two models provides insights regarding the respective contributions of forage production and concentration in the decline and the restoration of wading bird nesting in the Everglades.

Most of the decline in wading bird nesting in the Everglades has involved abandonment of traditional coastal and tributary colony sites along the mangrove estuaries in the southern part of the system. Nesting colonies now form mostly in the water conservation areas, where colonies often fail to produce fledging young.

The shift in location of wading bird nesting from the southern Everglades to the water conservation areas closely corresponds to the fish habitat suitability index output indicating a shift in location of habitat supporting high fish population densities from Shark River Slough to artificially pooled areas of WCA 3 and LNWR. The return of habitat supporting high fish densities to Shark River Slough in the restored system should contribute to the return of wading bird nesting to the mangrove fringe of the southern Everglades.

The wading bird habitat suitability index indicates that water depths and recession rates in the coastal zone of the southern Everglades provide a stable, high quality foraging habitat for wood storks under natural, current, and restored scenarios. This stability and high quality of foraging conditions, in combination with the decline in habitat suitability for the production of high fish densities, suggests that wood stork nesting in the southern Everglades may be limited by the production rather than the concentration of suitable prey organisms. This argument is strengthened by the size distribution of the fishes upon which the storks feed. Wood storks eat fishes greater than 10 centimeters (4 inches) in length, consisting largely of centrarchids (sunfishes), which require prolonged hydroperiod durations for growth to that size. Since hydroperiod duration is the controlling variable in the fish habitat suitability index, it makes sense that the decline and projected recovery of wood stork nesting in the southern Everglades corresponds closely to outputs from the fish habitat suitability index.

The wading bird habitat suitability index indicates that water depths and recession rates in the coastal zone of the southern Everglades also provide a stable, high quality foraging habitat for white ibis and small herons under natural and restored scenarios. However, white ibis and small herons differ from wood storks in that their foraging habitat

in the coastal zone is degraded under current conditions. The reduced stability and quality of foraging conditions, in combination with the decline in habitat suitability for the production of high fish densities, suggest that white ibis and small heron nesting in the southern Everglades currently may be limited by both the production and the concentration of suitable prey organisms.

The fish habitat suitability index suggests that wood storks, white ibis, and small herons may be drawn to the water conservation areas under current conditions by the shift in distribution of long-hydroperiod habitats supporting high fish densities. However, the wading bird habitat suitability index suggests that water depths and recession rates there provide lower quality foraging habitat in comparison to the coastal zone of the southern Everglades under all scenarios. Thus, the quality of foraging habitat, rather than the production of an adequate prey base, would appear to limit wood stork, white ibis, and small heron nesting success in the water conservation areas.

Trade-off between Periphyton Community and Other Variables in the Ridge and Slough Landscape

The proliferation of a floating mat periphyton community in Shark River Slough under current conditions appears to be an artifact of drainage. The periphyton habitat suitability index indicates that this community would disappear from most of northeastern and mid-Shark River Slough under natural and restored patterns of hydroperiod duration and depth. The same trend is seen in the estuarine interface of southern Shark River Slough. Maintaining floating mat communities in Shark River Slough under reduced hydroperiod and depth patterns would represent a trade-off between managing for floating periphyton mats versus the other ecological attributes that would benefit from hydrologic restoration. The periphyton habitat suitability index is based on our current understanding of periphyton ecology and distribution in the Everglades, more so than our knowledge of the historial distribution of periphyton communities.

Another anomaly in the output of the periphyton habitat suitability index is the distribution of high quality habitat for floating mat periphyton over most of WCA 2A under current hydrologic conditions. This accurately depicts observed mat development in portions of WCA 2A prior to eutrophication. However, eutrophication has eliminated periphyton mats from much of northern WCA 2A.

Summary

These relationships among groups of habitat suitability index models are of course based on the particular functions that were defined and how they were combined in any hydrologic simulation. These assumptions may change over time as new knowledge becomes available. In addition, new habitat suitability index functions may be added for other indicator species. Hence, the conclusions drawn above, while we believe to be accurate, are more intended to illustrate how information can be derived from such habitat

suitability index modeling exercises in leu of more detailed ecosystem monitoring and modeling.

While ecosystem habitat is not necessarily a measure of ecosystem response or condition, it is a reasonable approximation. The challenge, of course, is not only in defining habitat suitability functions that reasonably define those links between the water being managed and the relative ecosystem habitat response but also of combining, over time and/or over space, various habitat indicators for various ecological indicator species or landscape types.